and more thoroughly cut down, the river's wearing and transporting power being in proportion to the great beds of shale, sandstone, and limestone.

In many localities in the state of New York and elsewhere, there are glens and ravines cut wholly out of the Genesee and Hudson River shales, where there are no alternations of hard and soft strata, as in the Portage. Precipitous hillsides are also of frequent occurrence, although the face of the rock soon turns to soil. The reason why the edge of apparently so soft a rock of such fine material withstands the weather, and presents these naked sections for such a length of time in mural banks in ravines, river-courses, and upon the shores of lakes, is on account of its uniformly foliated structure. A very slight examination will serve to show the thin laminae of which the entire rock is composed, like sheets of paper, reminding one of the resisting power of the edge of a book. The hardness of some kinds of coal is also owing to its laminated formation. A precipitous wall, whether built by nature or by art, must either be laid with a good cement, or it must be composed of material having a good bed, 'breaking joints' both inward and laterally.

A peculiarity of the loess or bluff formation on the Mississippi and Missouri Rivers is, that although it is very fine, soft, and easily excavated with the spade alone, yet it presents very steep slopes and precipices resembling those of solid rocks. Unlike all other formations of an earthy nature, it remains unchanged by the atmosphere and the action of frost. Road-cuts and embankments, however steep, stand for years like a wall; and wells dug in it require to be walled only to a point above the water-line, while the remainder stands so securely without support, that the spade-marks remain upon it for years, although it is not at all cemented together. In the city of St. Joseph, and all other places where the bluff formation is found, these peculiarities can be easily seen; and they appear very remarkable to an eastern man, accustomed to the sloping down of banks of sand and clay. The explanation of it is, that, as is well known, the bluff is a lacustrine deposit. The material forming it floated in flakes in a quiet, shallow lake. The minute particles, assuming a flattened form, however it may have been caused, were very quietly and gently deposited in layers, like little sheets of paper. There was no current, no movement of the particles to form rounded grains of sand, irregularly deposited in accidental disorder. On the contrary, the bluff is a well-built piece of miniature natural earth masonry, well bound together: hence there is no rolling tendency in the material, and, when cut down at right angles to the layers, it does not form a slope, like other kinds of earth. Thus, from precipices of rock of the heavier strata to those composed of the smallest, their mechanical structure is of great importance, and the same homely comparison of the 'stretchers and binders' of an artificial wall applies.

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THE EQUATORIAL COUDÉ.

IN spite of the loss of light in the two reflections from its mirrors, — which loss will vary with the condition of the reflecting silver films, but, under the best conditions, should not much exceed twenty per cent, — the equatorial coudé of the Paris observatory would seem to be the coming form for nine-tenths of the equatorial work of an observatory. This form of 'elbow equatorial' has been described of late in so many scientific periodicals, that it is sufficient here to say that the polar axis forms a part of the tube, at the upper end of which the observer sits like a microscopist at his desk, and at whose lower end a 45° mirror turns the course of the rays into a tube at right angles to the axis; and at the outer end of this tube is the objective, with still another 45° mirror outside of it, which turns round the axis of this tube. This gives the motion in declination, and the rotation of the whole round the polar axis gives the motion in right ascension. All the movements, the reading of all the circles, the illumination, and every thing connected with the management and use of the telescope, are directly under the observer's control as he sits at his desk, where there is every facility for attaching spectroscopic, photometric, and micrometric apparatus to the eye-piece end, which keeps its fixed position. Moreover, the observer and all this accessory apparatus can be entirely roofed in, and the room warmed in cold weather, if desired, and the observer made as comfortable, and the work as convenient, as that in any laboratory, while the whole heavens are at his command.

There can be no question as to the desirability of this, when compared with the discomfort and exposure in the common observatory dome, and with the difficulty of attaching accessory apparatus to, counterpoising, and using it upon, the moving end of an ordinary equatorial. Still further, the observing-room can be made entirely dark when desired; and the increased sensitiveness of the retina, under these circumstances, will be a great gain in delicate spectroscopic and photometric work. Also, in work upon the sun, the possibility of protecting the accessory apparatus entirely from the sun's direct rays, and even of working in the dark if desired, will be a great improvement upon the inconveniences unavoidable in the common observatory dome.

The important point is, whether equally good definition can be attained with these two extra reflections. Experience alone can decide this with certainty; but up to the limit already tried in the Paris instrument, about ten inches aperture, we have the strongest evidence of its possibility. Dr. Gill, astronomer at the Cape of Good Hope, in describing to the Royal astronomical society a flying visit to continental observatories, speaks of the Paris equatorial coudé as follows:—

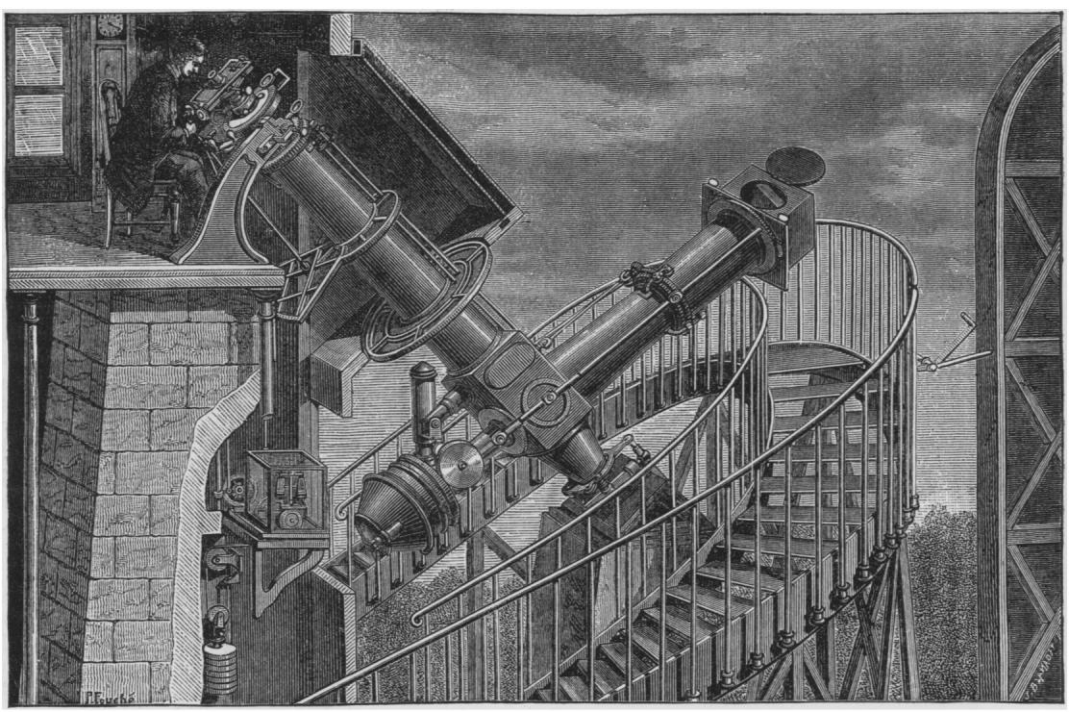
"One fine night, about eleven o'clock, we went to the observatory, and set on γ Leonis; and I am bound to say I never saw the diffraction-disks of a star better defined than in that instrument. They were perfectly circular. The disks came as sharply to focus as any I ever saw; and I would not have believed, if I had not seen it, that it was possible to make an instrument in which, after two reflections, such definition could be found. I am bound to say I never saw better definition in any instrument, and I never measured a double star so pleasantly and easily before."

Dr. Gill's well-known investigations in stellar astronomy give to whatever he says in this line great weight, and no stronger testimony could be desired.

When it comes to the question of the largest apertures, it would seem, *a priori*, that there should be no difficulty in making a glass mirror — where the internal constitution of the glass is not in question, and only one plane surface is demanded — 1.41 times as large as an objective, in which the glass of the two lenses must be homogeneous throughout, and four perfect surfaces are required.

Also it would seem, that if large lenses, whose thickness is limited, can be supported at the rim so that the distortions due to gravity are not appreciable in the definition, then mirrors whose thickness is unlimited, and which can be supported in every possible way at the rim, and all over the back surface, might be made sufficiently rigid to resist distortion. To be sure, the effects of distortion are of quite a different order in the two cases, the effect of gravity in increasing the curvature of one side of a lens being partly counteracted by the diminished curvature of the other side, while the distortion of a single reflecting surface appears with its full effect in the definition. But the far greater facilities for making the mirrors rigid should make up for this in a large degree. At any rate, the French opticians seem to have full confidence in their ability to do this, and it is certainly to be hoped that they will succeed.

Washington. H. M. Paul.



EQUATORIAL COUDÉ AT THE PARIS OBSERVATORY. (Reproduced from *l'Astronomie.*)

THE ECHINODERMS DREDGED BY THE TALISMAN.[1]

Among the deep-sea echinoderms, some of the holothurians attain a large size, one being seventy centimetres long. The mouth is situated at one end of the body, although near the termination of the

[1] Abridged from the French of H. Filhol in *La Nature.*